

1   **CLAIMS**

2   I claim:

- 3       1. A gas purification system for the effective sterilization of microorganisms within  
4       a waste effluent stream, the system comprising at least one light source connected  
5       by at least one optical connection positioned to provide a focused, controllable  
6       light output to a gas purifier, and a control mechanism, wherein the gas purifier is  
7       connected to a channel housing the waste effluent stream and the focused,  
8       controllable light output emitted thereby is projected into the waste effluent  
9       stream for producing at least one UV dose zone within the waste effluent stream  
10      for the effective sterilization of microorganisms in a gas.
- 11      2. The gas purification system according to claim 1, wherein the light source is an  
12      illuminator including at least one lamp, at least one optic, a housing, and a power  
13      supply.
- 14      3. The gas purification system according to claim 1, wherein the light source is at  
15      least one UV lamp.
- 16      4. The gas purification system according to claim 3, wherein the UV lamp is a high-  
17      intensity lamp.
- 18      5. The gas purification system according to claim 4, wherein the UV lamp is  
19      selected from the group consisting of an electrodeless lamp, a mercury halide  
20      lamp, a spectral calibration lamp, light emitting diodes (LEDs), lasers, and light  
21      emitting polymers.
- 22      6. The gas purification system according to claim 3, wherein the UV lamp emits  
23      light in the UVV and UVC wavelengths.

- 1        7. The gas purification system according to claim 3, wherein the light source  
2        includes at least one light source optical component positioned to provide a  
3        focused, controllable light output to a gas purifier.
- 4        8. The gas purification system according to claim 7, wherein the light source optical  
5        component is UV transmissive.
- 6        9. The gas purification system according to claim 7, wherein the light source optical  
7        component is UV reflective.
- 8        10. The gas purification system according to claim 10, wherein the at least one light  
9        source optical component is selected from the group consisting of reflectors,  
10       shutters, lenses, splitters, focalizers, mirrors, rigid and flexible light guides,  
11       homogenizer, mixing rods, manifolds and other couplers, filters, gratings,  
12       diffractors, gradient lenses, color wheels, off-axis reflectors, cascading reflectors,  
13       splitting reflectors, and combinations thereof.
- 14       11. The gas purification system according to claim 1, wherein the at least one optical  
15       connection is a fiber optic transmission line.
- 16       12. The gas purification system according to claim 1, wherein the fiber optic  
17       transmission line is removably connectable to the light source and the gas purifier.
- 18       13. The gas purification system according to claim 1, wherein the fiber optic  
19       transmission line is selected from the group of fiber optic transmission lines  
20       including acrylic lines, glass lines, liquid core lines, quartz lines, hollow core  
21       lines, core-sheath lines, dielectric coaxial lines, and combination thereof.
- 22       14. The gas purification system according to claim 1, wherein the gas purifier  
23       includes a dose zone that projects into the waste stream effluent.

- 1        15. The gas purification system according to claim 14, wherein the waste stream  
2        effluent channel housing is UV reflective.
- 3        16. The gas purification system according to claim 14, wherein the dose zone  
4        includes a portal for removable connection to a fiber optic transmission line.
- 5        17. The gas purification system according to claim 16, further including at least one  
6        portal optical component positioned between the portal opening and the interior of  
7        the gas purifier.
- 8        18. The gas purification system according to claim 17, wherein the at least one portal  
9        optical component is UV transmissive.
- 10       19. The gas purification system according to claim 17, wherein the at least one portal  
11       optical component is UV reflective.
- 12       20. The gas purification system according to claim 17, wherein the at least one portal  
13       optical component is selected from the group consisting of reflectors, shutters,  
14       lenses, splitters, focalizers, mirrors, rigid and flexible light guides, homogenizer,  
15       mixing rods, manifolds and other couplers, filters, gratings, diffractors, gradient  
16       lenses, color wheels, off-axis reflectors, cascading reflectors, splitting reflectors,  
17       and combinations thereof.
- 18       21. The gas purification system according to claim 14, wherein the dose zone uses  
19       enhanced two-dimensional design to improve the gas purification.
- 20       22. The gas purification system according to claim 14, wherein the dose zone uses  
21       enhanced three-dimensional design to improve the gas purification.
- 22       23. The gas purification system according to claim 14, wherein the dose zone  
23       includes a delivery device positioned within the waste effluent channel housing.

1        24. The gas purification system according to claim 23, wherein the delivery device  
2        includes at least one light emitter selected from the group consisting of side-  
3        emitting fiber optic transmission lines, end-emitting fiber optic transmission line,  
4        and combinations thereof.

5        25. The gas purification system according to claim 23, wherein the delivery device  
6        further includes at least one particle arrestor.

7        26. The gas purification system according to claim 25, wherein the at least one  
8        particle arrestor is a surface area enhancer.

9        27. The gas purification system according to claim 26, wherein the surface area  
10       enhancer includes fibers selected from the group consisting of glass fibers, acrylic  
11       fibers, quartz fibers, paper fibers, cellulose fibers, cotton fibers, plastic fibers, and  
12       combinations thereof.

13       28. The gas purification system according to claim 26, wherein the fiber filter is  
14       manufactured in a method selected from the group consisting of non-woven,  
15       woven, and knitted methods, including multi-layer structure.

16       29. The gas purification system according to claim 26, wherein the fiber filter is  
17       disposable.

18       30. The gas purification system according to claim 23, wherein the delivery device  
19       further includes at least two particle arrestors in series.

20       31. The gas purification system according to claim 23, wherein the delivery device  
21       includes catalytic surfaces.

22       32. The gas purification system according to claim 31, wherein the catalytic surfaces  
23       are self-cleaning.

1        33. The gas purification system according to claim 31, wherein the catalytic surfaces  
2        are photocatalytic surfaces containing at least one photocatalyst.

3        34. The gas purification system according to claim 33, wherein the at least one  
4        photocatalyst is a light-activated, dielectric semiconductor.

5        35. The gas purification system according to claim 33, wherein the at least one  
6        photocatalyst is selected from the group consisting of TiO<sub>2</sub>, WO<sub>2</sub>, ZnO, ZnS,  
7        SnO<sub>2</sub>, PtTiO<sub>2</sub>, other compounds known to be photocatalytic, including organic  
8        polymers, and combinations thereof.

9        36. The gas purification system according to claim 1, wherein at least one interior  
10       surface of the gas purifier and the waste effluent stream channel housing has a UV  
11       reflective surface.

12       37. The gas purification system according to claim 36, wherein the at least one UV  
13       reflective surface is selected from the group consisting of stainless steel,  
14       aluminum, and combinations thereof.

15       38. The gas purification system according to claim 1, wherein the interior of the gas  
16       purifier includes at least one interior optical component that is attached to the  
17       interior surfaces.

18       39. The gas purification system according to claim 38, wherein the at least one  
19       interior optical component is UV transmissive or UV reflective.

20       40. The gas purification system according to claim 38, wherein the at least one  
21       interior optical component is selected from the group consisting of reflectors,  
22       shutters, lenses, splitters, focalizers, mirrors, rigid and flexible light guides,  
23       homogenizer, mixing rods, manifolds and other couplers, filters, gratings,

1           diffractors, gradient lenses, color wheels, off-axis reflectors, cascading reflectors,  
2           splitting reflectors, and combinations thereof.

3           41. The system of claim 23, further providing UV irradiation countercurrent to the  
4           gas flow.

5           42. The system of claim 41, wherein the delivery device is protected from the gas  
6           flow.

7           43. The system of claim 41, wherein the protection is a shield.

8           44. The system of claim 41, wherein the delivery device is outside the gas flow.

9           45. The system of claim 44, wherein the delivery device is in a blind duct  
10          configuration.

11          46. A gas purifier for the effective sterilization of microorganisms in a gas, the gas  
12          purifier including a dose zone positioned within a waste effluent stream, thereby  
13          producing at least one dose region for the effective sterilization of  
14          microorganisms in the waste effluent stream.

15          47. The gas purifier system according to claim 46, wherein the waste effluent stream  
16          is contained by a channel housing that is UV reflective.

17          48. The gas purifier according to claim 46, further including at least one particle  
18          arrestor positioned within the waste effluent stream.

19          49. The gas purifier according to claim 48, wherein the at least one particle arrestor is  
20          a fiber filter.

21          50. The gas purifier according to claim 48, wherein the fiber filter is composed of  
22          fibers selected from the group consisting of glass fibers, acrylic fibers, quartz

1 fibers, paper fibers, cellulose fibers, cotton fibers, plastic fibers, and combinations  
2 thereof.

3 51. The gas purifier according to claim 48, wherein the fiber filter is manufactured in  
4 a method selected from the group consisting of non-woven, woven, and knitted  
5 methods, including multi-layer structure.

6 52. The gas purifier according to claim 48, wherein the fiber filter is disposable.

7 53. The gas purification system according to claim 48, further including at least two  
8 particle arrestors in series.

9 54. The gas purifier according to claim 48, further including catalytic surfaces on the  
10 particle arrestor.

11 55. The gas purifier according to claim 54, wherein the catalytic surfaces are self-  
12 cleaning.

13 56. The gas purifier according to claim 54, wherein the catalytic surfaces are  
14 photocatalytic surfaces containing at least one photocatalyst.

15 57. The gas purifier according to claim 56, wherein the at least one photocatalyst is a  
16 light-activated, dielectric semiconductor.

17 58. The gas purifier according to claim 56, wherein the at least one photocatalyst is  
18 selected from the group consisting of TiO<sub>2</sub>, WO<sub>2</sub>, ZnO, ZnS, SnO<sub>2</sub>, PtTiO<sub>2</sub>, and  
19 combinations thereof.

20 59. The gas purifier according to claim 46, wherein at least one interior surface of the  
21 gas purifier is a UV reflective surface.

1       60. The gas purifier according to claim 59, wherein the at least one UV reflective  
2       surface is selected from the group consisting of stainless steel, aluminum, and  
3       combinations thereof.

4       61. The gas purifier according to claim 46, wherein an interior of the gas purifier  
5       includes at least one interior optical component that are attached to the interior  
6       surfaces.

7       62. The gas purifier according to claim 61, wherein the at least one interior optical  
8       component is UV transmissive.

9       63. The gas purifier according to claim 61, wherein the at least one interior optical  
10      component is UV reflective.

11      64. The gas purifier according to claim 61, wherein the at least one interior optical  
12      component is selected from the group consisting of reflectors, shutters, lenses,  
13      splitters, focalizers, mirrors, rigid and flexible light guides, homogenizer, mixing  
14      rods, manifolds and other couplers, filters, gratings, diffractors, gradient lenses,  
15      color wheels, off-axis reflectors, cascading reflectors, splitting reflectors, and  
16      combinations thereof.

17      65. The gas purifier according to claim 46, wherein the effluent stream is produced by  
18      industrial or mechanical combustion.

19      66. A method for the purification of an effluent stream, comprising the steps of:  
20      providing a gas purifier comprising at least one light source connected by at least  
21      one optical connection positioned to provide a focused, controllable light output  
22      to a gas purifier, and a control mechanism, thereby producing at least one UV  
23      dose zone for the effective sterilization of microorganisms in a gas, activating the



- 1 UV light source, passing the gas through the gas purifier, thereby providing a
- 2 sterilized gas stream.